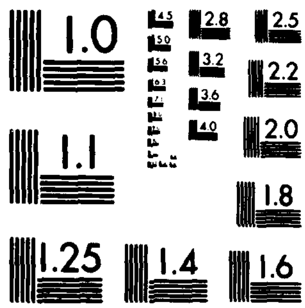
AD-A110 281 DEFENSE MAPPING AGENCY AEROSPACE CENTER ST LOUIS AFS MO F/G 8/2
THE DEVELOPMENT OF SMALL SCALE MAP CONTROL VIA DIGITAL PANELING--ETC(U)
1982 C A ERPENBACH

UNCLASSIFIED NL

END
DATE
FILMED
3 82
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A110281	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) THE DEVELOPMENT OF SMALL SCALE MAP CONTROL VIA DIGITAL PANELING OF LARGE SCALE MAP SOURCE,		5. TYPE OF REPORT & PERIOD COVERED Technical Paper
		6. PERFORMING ORG. REPORT NUMBER N/A
7. AUTHOR(s) Charles A. Erpenbach		8. CONTRACT OR GRANT NUMBER(s) N/A
9. PERFORMING ORGANIZATION NAME AND ADDRESS DMAAC/CDAP St. Louis AFS, MO 63118		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS N/A
11. CONTROLLING OFFICE NAME AND ADDRESS Defense Mapping Agency Washington, DC 20305		12. REPORT DATE 1982
		13. NUMBER OF PAGES 6
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) LEVEL II		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Open Publivcation

DTIC ELECTE FEB 1 1982 S D H

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

For presentation at the 2nd Technical Exchange Week (Panama, 25-29 Jan 1982) and the 1982 ACSM-ASP Annual Convention (Denver, Colorado - 15-19 March).

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Digital Paneling

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A digital method has been devised which circumvents the traditional photo-mechanical reduction of large scale map source and the subsequent manual paneling of those reductions to a smaller scale control projection. The method requires the automatic digitization (via a scanner) of overlays which depict selected features compiled from the large scale source. The scanned data is vectorized. At a digital edit station, the data is then mathematically transformed to the desired compilation projection using common control

DD FORM 1473, 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED 1/6/82

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

4C7189

20. ABSTRACT (Continued)

points. Through file merging, the data sets are collected and input to a high-speed plotter where planimetric and hypsographic control bases are plotted for chart compilation.

THE DEVELOPMENT OF SMALL SCALE MAP CONTROL VIA DIGITAL PANELING OF LARGE SCALE MAP SOURCE

CHARLES A. ERPENBACH
Defense Mapping Agency Aerospace Center, DMAAC
St. Louis, Missouri 63118

BIOGRAPHICAL SKETCH

Mr. Erpenbach received his bachelor of science degree in Geography in 1974 from South Dakota State University. Since graduation he has been pursuing specialty courses in computer processing. He began his career in the field of cartography at the Defense Mapping Agency Aerospace Center in 1976. His background gained in product requirements along with his experience as a journeyman and supervisory cartographer led him to his current position in the Cartography Department Air Target Materials/Nav-Plan Division Technical Office. Mr. Erpenbach is a member of the American Congress on Surveying and Mapping.

ABSTRACT

A digital method has been devised which circumvents the traditional photomechanical reduction of large scale map source and the subsequent manual paneling of those reductions to a smaller scale control projection. The method requires the automatic digitization (via a scanner) of overlays which depict selected features compiled from the large scale source. The scanned data is vectorized. At a digital edit station, the data is then mathematically transformed to the desired compilation projection using common control points. Through file merging, the data sets are collected and input to a high-speed plotter where planimetric and hypsographic control bases are plotted for chart compilation.

INTRODUCTION

Conventional chart production (paneling, compilation, negative engraving) requires highly labor-intensive manual skills. The advent of automated color separation minimized the negative engraving skill, but little has been done to simplify the cartographer's task of producing a set of compilation manuscripts for either manual or automated color separation. At the Defense Mapping Agency Aerospace Center (DMAAC), a method has been developed that obviates the compiler's need to produce a panel base and subsequently draft planimetric and hypsographic manuscripts. At DMAAC, this method is called digital paneling.

CONVENTIONAL CHART PRODUCTION METHOD

To appreciate the concept of digital paneling, one must have a full grasp of the chart production method historically used at DMAAC. For the sake of illustration, let us consider the production of a Domestic Series 200 chart. This chart, produced at a scale of 1:200,000 on a Lambert Conformal Conic

(LCC) projection, is used in Strategic Air Command training missions over the continental United States. The primary cartographic sources incorporated into this Series 200 are the 7½ minute and 15 minute United States Geological Survey (USGS) quadrangle sheets. These sheets are produced at 1:24,000 and 1:62,500 scale respectively on a Polyconic projection. This cartographic source lends itself well to Series 200 chart compilation. The similarity of projections allows simple photo reduction of the source and thus, provides for excellent map control. Furthermore, the scale differential between the source and the compilation is considered to be the optimum in terms of economically capturing chart detail and maintaining positional accuracy. Symbology common to USGS and the 200 Series is also advantageous (e.g. non-perennial streams on the cartographic source are portrayed as non-perennial streams on the final product).

After assembling the cartographic source package, the compiler begins his assignment by highlighting (via a wide-line marking medium) those planimetric and hypsographic features that satisfy the Series 200 specifications for portrayal. During this highlighting process the compiler also assures sheet to sheet matching, for as many as 120 USGS 7½ minute sheets may be used in a single Series 200 chart. When the cartographer is satisfied with the selection, the next step is to scale the sheets for photo reduction. Due to paper shrinkage, each sheet must be scaled against the LCC projection to insure proper fit. Four mil film positive reductions produced in the photo lab are manually paneled (mosaicked) to the LCC projection. This serves as the panel base from which final planimetric, hypsographic and special feature manuscripts are drafted. For quality assurance purposes, these manuscripts are compiled at an intermediate scale of 1:125,000. They are subsequently photographically reduced to final chart scale (on scribing material) for negative engraving.

CHART PRODUCTION METHOD FOR AUTOMATED COLOR SEPARATION

With only minor exceptions, the chart production methods governing the conventional manuscript compilation apply to the automated method as well. While no concessions are made regarding the specifications of the chart series, the drafting symbology used to compile the manuscripts must be altered to maximize the scanability and minimize the editing on the processing system. The processing system referred to here is DMAAC's Automated Graphic Digitizing System (AGDS). The AGDS has three components:

a. The Scanner Subsystem - This computer and 40" X 60" scanning table configuration collects data in raster format via a laser sensor.

b. The Vectorizer Subsystem - The unique feature of the AGDS is the capability to convert raster data to vector (linear) data. The vectorizer subsystem accomplishes this function.

c. The Edit Subsystem - This subsystem permits manipulation of the linear data. Deficiencies incurred during

the pre-processing (primarily, deficiencies in the scanned graphic) become apparent here and can be corrected. For a maintenance program, previously digitized data can be input to this subsystem and additions, deletions and corrections can be made. The AGDS, in conjunction with feature code software and the Government's high-speed plotters, can effectively automate the negative engraver's job of hand-scribing.

THE DIGITAL PANELING METHOD AND ITS ADVANTAGES

The cartographic functions detailed previously (i.e. scaling, mosaicking, drafting etc.) are essential to producing controlled and accurate color separation manuscripts but they are also laborious. While the automated color separation process obviates the need for hand-scribing, the AGDS can also eliminate the equally tedious and time-consuming task of drafting the compilation manuscripts. Rather than submitting highlighted USGS sheets to the photo lab for reductions and subsequent manual paneling to the projection, the compiler submits the projection and selected feature lifts to the AGDS. These selected feature lifts are mylar overlays depicting hypsography, planimetry and geographic control points from the cartographic source. The projection is scanned and vectorized by the AGDS and set aside as the master/projection file. The lifts/overlays are processed similarly and stored in separate digital files as data sets of the Series 200. Now the edit system operator can transform (digitally reduce as opposed to photographically reduce) a data set to its proper position in the master/projection file using the geographic control points common to both files. Through a sequential processing step each data set is transformed and merged to the preceding data set until a single file is created. This digitally paneled file is plotted and returned to the cartographer for revision/updating. This method serves to:

a. Circumvent the need for photo services. Depending upon the workload in the photo lab, considerable calendar time can be saved as well as saving the expense of manpower and materials.

b. Eliminate the need for scaling. Digital transformation of data sets is dependent only upon common control points rather than a photo reduction factor.

c. Eliminate the need to manually panel film reductions. This represents a time savings of 40-60 hours for the compiler. Furthermore, the compiler does not have to contend (due to scaling or camera precision errors) with unusable oversized reductions or undersized reductions that require additional mosaicking to distribute the residual error.

d. Eliminate the need to draft a set of manuscripts from the panel base. An extensive contour manuscript in a high relief area may require 100-150 hours to compile. With the data in digital form the cartographer need only revise the plot for corrections and indicate to the edit system operator the appropriate feature codes for color separation.

e. Relieve the tedium of the more mundane cartographic functions. With scaling eliminated and drafting minimized, more time is available to insure chart quality and/or increase productivity.

f. Provide for multi-use data base building. In conjunction with or apart from the automated color separation process, the data is on file for further manipulation. The feature code not only provides the means for automated color separation but also the means of retrieval from the data base. For planimetric detail undergoing automated color separation, the applied feature code is sufficient for data base retrieval. For hypsographic detail, a second feature code must be applied. It is important not only to know that a feature is a contour but also to know the value of that contour. In this way users can query the data base for contours relative to smaller scale chart series with differing basic contour intervals. By building a Chart Feature File at our largest scale, we have the capability to build subsequent data bases for most charting needs. Problems such as feature hierarchy, feature displacement and line simplification are being addressed for maximum effectiveness of these subsequent data bases.

DISADVANTAGES

This digital paneling method is not without its disadvantages as well. An advantage of the manual paneling method is that the compiler is able to recapture any features overlooked during the cartographic source highlighting step by having the actual source map photographically reduced. The digital paneling method (because selected feature lifts are used) places a greater demand on the compiler to insure that all features have been properly and accurately portrayed prior to processing.

Because of compilation errors on the selected feature lifts or errors produced by the scanner, numerous edit corrections may be required. With a manually paneled base, the cartographer can easily correct compilation errors while drafting the manuscripts. To edit a digitally paneled file, however, the system operator must pore through the entire file to make corrections. Therefore, a very large file compounded by a correspondingly large number of corrections yields a sharply reduced throughput rate for the system. This point is particularly meaningful when considering the contour file. Because the contour is the most abundant feature portrayed on the chart, the vector data defining that contour file is voluminous. This volume of data can best be illustrated by visualizing the physical size of the processed input. By processing the cartographic source at full scale the digital file represents an area of over 200 square feet rather than the six square feet reflected graphically on the final chart!

SOLUTIONS/IMPROVEMENTS

The disadvantages are really not as alarming as they may seem. A seasoned compiler needn't fear overlooking valuable cartographic detail if care is exercised while drafting the selected feature lifts. The other disadvantages center around

the depressed throughput rate of the digitizing system. The key to cost-effective digital paneling (and efficient automated color separation and data base building) is to minimize the editing time. Two proven solutions are available to optimize the throughput rate. Firstly, in a production mode, the edit system operator will edit the individual data files prior to transformation to the projection. In this manner, the editing of a relatively small volume of data is facilitated by a quickened computer response. The result after transformation is a virtually edit-free data file.

The second solution, which can be used in tandem with the first, dismisses one of the merits of the digital paneling method described previously in the circumvention of the traditional photomechanical reduction, yet by disregarding this benefit we can considerably accelerate the AGDS processing. The scanning system processing rate is strictly a function of physical size (approximately 3.5 square inches per minute). By producing a clear-image film positive reduced by a factor of n, the area to be scanned is reduced by a factor of n^2. Using the scanning system processing rate for a USGS 1:24,000 quad sheet (23" X 16") versus that same source reduced to approximate compilation scale (approximate in that the data is still being digitally paneled and a straight reduction factor for all sheets will suffice), scanning time is reduced from about 105 minutes to just over 4 minutes to collect the raster/pixel data. Throughput of the vectorizer system, contrary to the scanning system, is dependent upon volume. With lesser pixel definition, the vectorizer logically has fewer points to operate on yielding improved time in converting raster to vector data. This time savings is further magnified during the transformation process on the edit system. The reduced amount of vector data allows for greater ease of handling by the edit system computer. In short, the use of a photo reduction as the scanning medium equates to a data thinning algorithm on the processing system. It is important to note, through comparison studies of manual and digital paneling at full and reduced scale, that the integrity of the data is not diminished. Actual positional evaluations are yet to be determined. However, the expected results should weigh in favor of digital paneling due to the capability of the AGDS to more uniformly distribute the panel base error.

The use of reduced film positives as a scanning medium can be expanded. The current procedure has a cartographic technician monitoring the scanner to mount successive film reductions and post-process the data. By mounting several film reductions at the end of a second shift the scanner can be left unattended to process data during a third shift. An edit system operator can call up this data the following day and, by splitting the subsets from the file, provide editing tasks for other operators. In this way, the production manager can maximize the use of equipment. Furthermore, by anticipating user's needs, the manager can dedicate equipment (during non-peak production cycles) to process data in an assembly line operation for the data base.

Other improvements are being considered to streamline digital paneling and optimize throughput. Firstly, the projection plotting software is independent of the AGDS. With this

software on-line, the need to produce a compilation scale projection (and subsequently scan and vectorize that projection) could be eliminated. Secondly, the implementation of software providing for non-orthogonal projection transformation would allow greater application to DMAAC's wide variety of products. Lastly, the technical advances of digital paneling and automated color separation have drastically reduced the requirement for manuscript drafting and engraving skills. The next step is to eliminate the need to make the selected feature lifts. A color scanner (though prototypical) using USGS litho copy or the current AGDS scanner using a clear image film positive of USGS repromat (primarily the contour plate) could make this possible. In both cases, the cartographer would be tasked with simply saving (via a clean file) the essential data and then deleting the remaining data file that does not meet specifications for portrayal on a particular chart series. Furthermore, the integrity of the data saved would be rigidly maintained.

SUMMARY

Someday drafting and scribing tools may be obsolete. Someday integrated systems may be developed that will automatically collect, identify and file cartographic features. Someday digital data bases may be the direct link between high-speed plotters/printers and the user. But until that day comes, applications such as digital paneling will attempt to satisfy the growing needs of the mapping community.

ATE
LME
-8